INCH-POUND

MIL-S-19500/521B(ER)
20 April 1992
SUPERSEDING
MIL-S-19500/521A(ER)
31 January 1989

MILITARY SPECIFICATION

SEMICONDUCTOR DEVICE, DIODE, LIGHT EMITTING, GREEN TYPES JAN1N6094, JANTX1N6094, JAN1N6611 (CLEAR LENS), JANTX1N6611 (CLEAR LENS), AND PANEL MOUNTED ASSEMBLY TYPES JANM19500/52101, JANTXM19500/52102, JANM19500/52103 (CLEAR LENS), AND JANTXM19500/52104 (CLEAR LENS)

This specification is approved for use by the US Army Laboratory Command, Department of the Army, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the detail requirements for JAN and JANTX green light emitting diodes in a hermetic-sealed can and panel mount assemblies made from the same hermetic light emitting diode units. See 6.2c for an explanation of Part or Identifying Numbers (PIN's).

1.2 Physical dimensions. See figures 1 and 2.

1.3 Maximum ratings.

I_F	I_P 1/	I_{ptr} 2/	$V_{(BR)}$ 3/	P_{FM} 4/	T_{op}	T_{stg}
mA dc	mA(pk)	A(pk)	V dc	mW(pk)	°C	°C
35	60	1.0	5	120	-65°C to +100°C	-65°C to +100°C

1/ Pulse width maximum 0.5 ms and $P_{FM(AV)}$ less than P_F.
2/ I_{ptr} = 1 µs pulse width, 300 pulses per second (pps).
3/ I_R = 10 µA dc.
4/ Derate linearly from 50°C at 1.6 mW/°C.

1.4 Characteristics, radiometric (physical), and photometric (visual).

Limits	I_{V1} I_F = 20 mA dc Θ = 0°		I_{V2} I_F = 20 mA dc Θ = 30°	V_F I_F = 20 mA dc	λ_V (wavelength)	Color	C V_R = 0 f = 1 MHz	I_R V_R = 3 V dc
	mcd		mcd	V dc	nm		pF	µA dc
	1/	2/				Green		
Min	3.0	20.0	1.5	---	550		---	---
Max	---	---	---	3.0	660		100	1

1/ Applies to JAN1N6094, JANTX1N6094, JANM19500/52101, and JANTXM19500/52102.
2/ Applies to JAN1N6611, JANTX1N6611, JANM19500/52103, and JANTXM19500/52104.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, US Army Laboratory Command, ATTN: SLCET-R-E, Fort Monmouth, NJ 07703-5302 by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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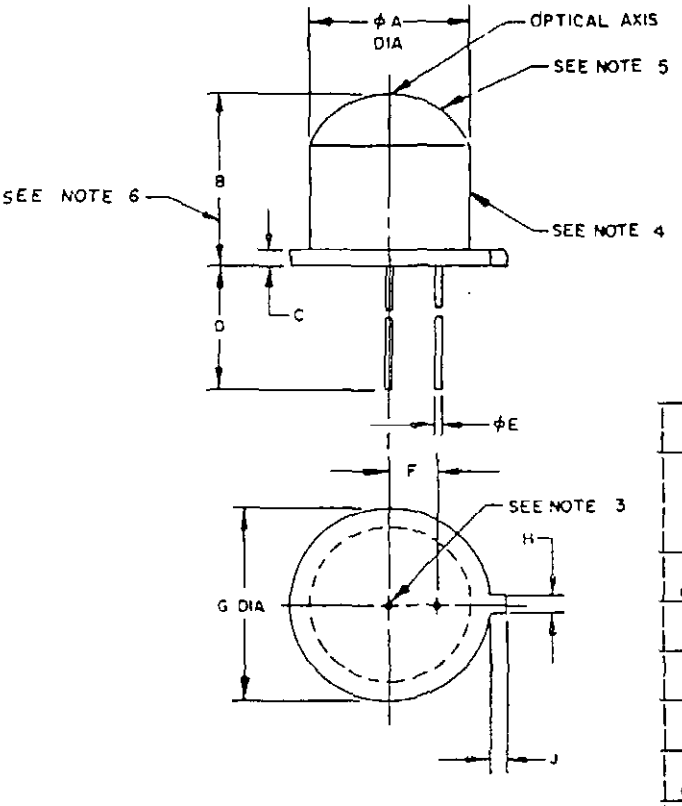

Dimensions				
Ltr	Inches		Millimeters	
	Min	Max	Min	Max
ϕA	.176	.190	4.47	4.83
B	.180	.225	4.57	5.72
C	.013	.024	0.33	0.61
D	.970	1.030	24.64	26.16
ϕE	.016	.019	0.41	0.48
F	.045	.055	1.14	1.40
G	.200	.220	5.08	5.59
H	.035	.045	0.89	1.14
J	.032	.042	0.81	1.07

NOTES:
1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Cathode lead; both leads isolated from case.
4. Glass/metal hermetic can.
5. Colored lens or clear glass lens (see 6.2c).
6. For sunlight viewable LED's, dimension B is .213 (5.41 mm) minimum and .260 (6.60 mm) maximum (see 6.2c).

FIGURE 1. Semiconductor device, diode, types JAN1N6094, JANTX1N6094, JAN1N6611, and JANTX1N6611.

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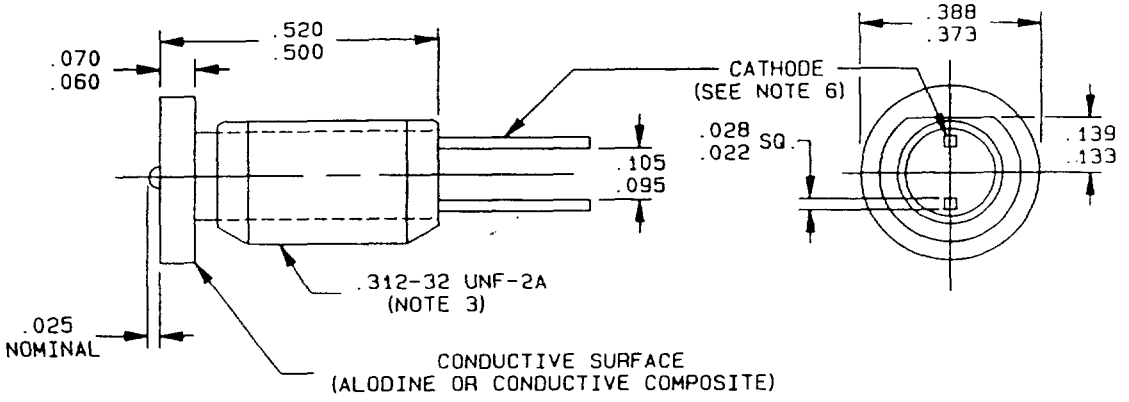

Inches	mm	Inches	mm
.022	0.56	.133	3.38
.025	0.64	.139	3.53
.028	0.71	.373	9.47
.060	1.52	.388	9.86
.070	1.78	.500	12.70
.095	2.41	.520	13.21
.105	2.67	.583	14.81

NOTES:
1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. The panel mount sleeve is either black conductive composite with a tensile strength of 35,000 psi and surface resistivity of 100 ohms per square inch, black anodized aluminum, or black finished zinc.
4. Mounting hardware, which includes one lockwasher and one hex nut, is included with each panel mountable hermetic solid state lamp.
5. Use of metric drill size 8.20 millimeters or English drill size P (.323 inch) is recommended for producing hole in the panel for panel mounting.
6. Both leads are isolated from the panel mount by nonconductive potting.
7. Conductive surface may extend to threaded area.

FIGURE 2. Semiconductor device, diode, types JANM19500/52101, JANTX19500/52102, JANM19500/52103, and JANTXM19500/52104 panel mount assemblies.

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2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATION

MILITARY

MIL-S-19500 - Semiconductor Devices, General Specification for.

STANDARDS

MILITARY

MIL-STD-750 - Test Methods for Semiconductor Devices.
MIL-STD-1241 - Optical Terms and Definitions.

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Document Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.2 Non-Government publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z7.1-1967 - Nomenclature and Definitions for Illuminating Engineering.

(Application for copies should be addressed to American National Standards Institute, 1430 Broadway, New York, NY 10018.)

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Associated detail specification. The individual item requirements shall be in accordance with MIL-S-19500, and as specified herein.

3.2 Abbreviations, symbols and definitions. The abbreviations, symbols, and definitions used herein are defined in MIL-S-19500, MIL-STD-1241, and as follows:

a. I_V - - - - - - - - - Luminous intensity (the subscript "v" is used to designate a photometric or visual quantity to differentiate from "I" as used herein for current).

b. λ_V - - - - - - - - - Peak radiometric wavelength of diode light emission. (The subscript "v" is used to designate a photometric or visual quantity to differentiate from λ used in the "LTPD" columns of tables I, II, III, and IV.)

c. I_P - - - - - - - - - Peak operating forward pulse current.

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d. I_{ptr} - - - - - - - - Peak transient forward current.

e. mcd - - - - - - - - - - Milli-candela; the candela is a unit of luminous intensity defined such that the luminance of a blackbody radiator at the temperature of solidification of platinum is 60 candelas per square centimeter.

f. ⊖ - - - - - - - - - - The angle at or off the axis of symmetry of a light source at which luminous intensity is measured.

g. LED- - - - - - - - - Light emitting diode.

3.3 Design, construction, and physical dimensions. Diodes shall be of the design, construction, and physical dimensions shown on figure 1. Panel mount assemblies shall be of the design, construction, and physical dimensions shown on figure 2.

3.3.1 Semiconductor chip material. Diodes are classified by chip construction material as gallium arsenide phosphide.

3.3.2 Lead finish. Lead finish shall be in accordance with MIL-S-19500 and MIL-STD-750. Leads finish may be specified in the contract (see 6.2).

3.3.3 Terminal lead length. Terminal lead length(s) other than that specified on figure 1 may be furnished when so stipulated in the acquisition document (see 6.2) where the devices covered herein are required directly for particular equipment-circuit installation or for automatic-assembly-technique programs.

3.4 Performance characteristics. Performance characteristics shall be as specified in tables I, II, III, and IV. Table IV is applicable to JAN and JANTX panel mount types only.

3.5 Marking. The following marking specified in MIL-S-19500 may be omitted from the body of the diode at the option of the manufacturer:

a. Country of origin.

b. Manufacturer's identification.

c. All marking on LEDs used in panel mount assemblies.

4. QUALITY ASSURANCE PROVISIONS

4.1 Sampling and inspection. Sampling and inspection shall be in accordance with MIL-S-19500, and as specified herein.

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-S-19500.

4.3 Screening. Screening shall be in accordance with MIL-S-19500 (table II) and as specified herein. The following measurements shall be made in accordance with table I herein. Devices that exceed the limits of table I herein shall not be acceptable.

4.3.1 Power burn-in conditions. Power burn-in conditions are as follows:

a. I_F = 35 mA dc (constant current).

b. t = 96 hours minimum.

c. T_A = 25°C.

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Screen (see table II of MIL-S-19500)	Measurements JANTX level
2	As given, except condition shall be 24 hours minimum at maximum rated storage temperature.
3	$T_{upper\ extreme}$ = 100°C, +0°C, -3°C
7	As given, except for the fine leak test, condition G, testing 2 hours after pressurization is acceptable and for the gross leak test, the device temperature shall be maintained at 100°C ±5°C.
9 and 10	Not applicable.
12	See 4.3.1.
13	Subgroup 2 of table I herein; ΔI_{V1} = -20 percent of initial readings. ΔV_F = ±50 mV dc.

4.4 *Quality conformance inspection*. Quality conformance inspection shall be in accordance with MIL-S-19500. The following shall apply:

a. If the manufacturer chooses the following option(s) for testing, the sample units that are to be used in group C inspection shall be designated as such prior to conducting the referenced group B tests. Moreover, the number of failed diodes to be counted for lot acceptance or rejection as a result of group C test shall be equal to all failed diodes of the test in group B inspection, which were predesignated for use in group C inspection, plus any additional failures occurring during group C testing. For each life test in group C inspection, the manufacturer has the option of using all or a portion of the sample already subjected to 340 hours of group B life testing for an additional 660 hours of testing to meet the 1,000-hour requirement.

b. Panel mount assemblies shall be assembled with LEDs that have met the requirements of tables I, II, and III, and the applicable screening requirements specified herein. The quality conformance inspection for panel mount assemblies shall consist of the examinations and inspections specified in table IV herein.

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with MIL-S-19500, and tables I and IV herein.

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in table IV of MIL-S-19500, and table II herein.

4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in table V of MIL-S-19500, and table III herein.

4.5 Methods of inspection. Methods of inspection shall be as specified in the appropriate tables and as follows.

4.5.1 Steady-state operation life. The diodes shall be forward biased at a maximum continuously applied current of 35 mA dc.

4.5.2 Resistance to solvents. All areas of the diode body where marking has been applied shall be brushed. After the test, there shall be no evidence of mechanical damage to the device and marking shall remain legible.

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4.5.3 Axial luminous intensity. This measurement is made with a photometer described, calibrated, and operated as follows.

4.5.3.1 Description of photometer.

4.5.3.1.1 Type of response. The photometer shall be of a type that is designed to respond to illuminance or (luminous incidence), that is, incident luminous flux density or lumens per unit area. Units for luminous incidence are lux (lm/m^2). The output of the photometer shall be linearly related to luminous incidence over the range of levels encountered in calibration and measurement. The output may be a voltage or a current, or may be rendered directly in the units of luminous incidence.

4.5.3.1.2 Spectral response. The relative response of the photometer shall be within 6 percent of $v(\lambda)$ at all wavelengths within the effective spectrum of devices to be measured, where $v(\lambda)$ is the photopic spectral luminous efficiency value as given in ANSI Z7.1-1967. The effective spectrum for a given type of device extends from the minimum to the maximum value of λ_v in 1.4.

4.5.3.1.3 Receptance pattern. The off-axis receptance of the photometer shall be constant over a large enough angle that it responds equally to light from all parts of the device to be measured. An effective plane of receptance (image of the detecting surface) shall be defined with respect to which the calibration can be performed.

4.5.3.2 Calibration of photometer. Radiation from a certified (NBS traceable) standard of spectral radiant incidence produces at its specified reference plane a known level of spectral radiant incidence, $E_e(\lambda)$ ($\mu W/cm^2$ per nanometer of wavelength). By passing this radiation through an interference filter of known spectral transmittance, τ_λ in a narrow band (<20 nm) centered at λ_0 (a dimensionless function of wavelength), a narrow band of spectral radiant incidence, $E_e(\lambda)\tau_e(\lambda)$ is obtained. This is converted to luminous incidence by integration:

$$E_v(\lambda_o) = 6.80 \int_0^\infty \left[E_e(\lambda)\tau_e(\lambda) \right] v(\lambda)\, d\lambda.$$

where: $E_v(\lambda_o)$ = luminous incidence (lux) at the reference plane of the standard of spectral radiant incidence, for a wavelength, $\lambda_o \approx \lambda_v$ (avg) $= \frac{\lambda_v \text{ (min)} + \lambda_v \text{ (max)}}{2}$.

$E_e(\lambda)\tau_e(\lambda)$ = spectral radiant incidence ($\mu W/cm^2/nm$) resulting from passing the flux from the standard of spectral radiant incidence $E_e(\lambda)$ through a filter of spectral transmittance $\tau_e(\lambda)$.

$V(\lambda)$ = Photopic spectral luminous efficiency value as given in ANSI Z7.1-1967.

6.80 = Units conversion constant (lux per $\mu W/cm^2$) obtained from the product of 680 lumens per watt, the peak of the standard observer response, and 10,000 cm^2/m^2.

With the photometer receptance plane at the reference plane of the standard of spectral radiant incidence, the luminous incidence thus calculated (in lux) is applied. The response of the photometer, to this standard luminous incidence is $P_{std}(\lambda_o)$.

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4.5.3.3 Operation of photometer. The LED to be measured is aligned at the angle specified in 1.4, and at a known distance, d(meters) from the receptance plane of the photometer. Specified drive current is applied to the LED and the luminous intensity is computed from the resulting photometer indications, P_{LED}:

$$I_{V_{LED}} = \frac{P_{LED}}{P_{std}(\lambda_o)} \cdot E_{V,(\lambda_o)} \cdot d^2.$$

where $I_{V_{LED}}$ = luminous intensity of the LED (candelas).

$\frac{P_{LED}}{P_{std}(\lambda_o)}$ = ratio of photometer response from LED to response from standard luminous incidence.

$E_V(\lambda_o)$ = standard luminous incidence (lux) calculated as above.

d = distance (meters) from emittance plane of LED to receptance plane of photometer.

NOTE: Use of the wavelength designator, λ_o implies only that the photometer response was calibrated at that wavelength. The interference filter should not be used with the photometer in measuring; it is used only for calibration.

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TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 1						
Visual and mechanical inspection	2071					
Subgroup 2						
Luminous intensity		I_F = 20 mA dc; Θ = 0° (see 3.2f and 4.5.3)	I_{V1}	3.0 2/ 20.0 3/		mcd mcd
Luminous intensity 2/		I_F = 20 mA dc; Θ = 30°	I_{V2}	1.5		mcd
Reverse current	4016	DC method; V_R = 3 V dc	I_R		1.0	µA dc
Forward voltage	4011	DC method; I_F = 20 mA	V_F		3.0	V dc
Subgroup 3						
High temperature:		T_A = 100°C				
Reverse current	4016	DC method; V_R = 3 V dc	I_R		1.0	µA dc
Forward voltage	4011	DC method; I_F = 20 mA	V_F		3.0	V dc
Low temperature:		T_A = -55°C				
Reverse current	4016	DC method; V_R = 3 V dc	I_R		1.0	µA dc
Forward voltage	4011	DC method; I_F = 20 mA	V_F		3.0	V dc
Subgroup 4						
Capacitance	4001	V_R = 0; f = 1 MHz	C		100	pF
Subgroups 5, 6, and 7						
Not applicable						

1/ For sampling plans, see MIL-S-19500.
2/ Applies to JAN1N6094 and JANTX1N6094.
3/ Applies to JAN1N6611 and JANTX1N6611.

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TABLE II. Group B inspection.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 1 2/						
Solderability 3/	2026					
Resistance to solvents	1022					
Subgroup 2						
Thermal shock (temperature cycle)	1051	Test condition A, except T(high) = 100°C; 25 cycles; t(extremes) ≥ 10 minimum				
Hermetic seal	1071	Test condition G or H; (for condition H, leak testing 2 hours after pressurization is acceptable)				
Fine leak						
Gross leak		Test condition A, C, D, E, J, or K except leak indicator fluid shall be maintained at 100°C ±5°C				
Electrical test		I_F = 20 mA dc,	I_{V1}	3.0 4/		mcd
Luminous intensity		Θ = 0° (see 3.2f and 4.5.3)		20.0 5/		mcd
Subgroup 3 6/						
Steady-state operation life	1027	I_F = 35 mA dc, 340 hours +72, -24 hours (see 4.4a and 4.5.1)				
Electrical test		Same as subgroup 2	I_{V1}	2.7 4/		mcd
Luminous intensity				18.0 5/		mcd
Subgroup 4						
Decap internal design verification 2/	2075	Test 1 device/0 failure each lot; in accordance with qualified design				
Subgroup 5						
Not applicable						

See footnotes at end of table.

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TABLE II. Group B inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 6						
High temperature life (nonoperating)	1032	T_A = 100°C, 340 hours +72, -24 hours (see 4.4a)				
Electrical test		Same as subgroup 2	I_{V1}	2.7 4/		mcd
Luminous intensity				18.0 5/		mcd

1/ For sampling plan, see MIL-S-19500.
2/ Electrical reject devices from the same inspection lot may be used for all subgroups when electrical end-point measurements are not required.
3/ The LTPD for solderability test applies to the number of leads inspected except in no case shall less than three devices be used to provide the number of leads required.
4/ Applies to JAN1N6094 and JANTX1N6094.
5/ Applies to JAN1N6611 and JANTX1N6611.

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TABLE III. Group C inspection.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 1 2/						
Physical dimensions	2066	See figures 1 and 2				
Subgroup 2						
Thermal shock (glass strain)	1056	Test condition A				
Terminal strength	2036	Test condition E				
Hermetic seal	1071					
Fine leak		Test condition G or H; (for condition H, leak testing 2 hours after pressurization is acceptable)				
Gross leak		Test condition A, C, D, E, J, or K, except leak indicator fluid shall be maintained at 100°C ±5°C				
Moisture resistance	1021	Omit initial conditioning				
Electrical test		I_F = 20 mA dc;	I_{V1}	3.0 3/		mcd
Luminous intensity		Θ = 0° (see 3.2f and 4.5.3)		20.0 4/		mcd
Subgroup 3						
Shock	2016	Nonoperating, 1500 G's, 0.5 ms, 5 blows in each orientation X1, Y1, and Z1				
Vibration, variable frequency	2056	Nonoperating				
Constant acceleration	2006	One minute in each orientation X1, Y1, and Z1 at 20,000 G's minimum				
Electrical test		Same as subgroup 2	I_{V1}	3.0 3/		mcd
Luminous intensity				20.0 4/		mcd
Subgroup 4						
Salt atmosphere (corrosion) 2/	1041					

See footnotes at the end of table.

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TABLE III. Group C inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 5						
Not applicable						
Subgroup 6						
Steady-state operation life	1027	I_F = 35 mA dc, 1,000 hours T_A = 25°C				
Electrical test		Same as subgroup 2	I_{V1}	2.7 3/ 18.0 4/		mcd mcd
Luminous intensity						
Subgroup 7						
Peak forward pulse current (transient)		t_p = 1 µs, pps = 300, total test time = 5 seconds I_{ptr} = 1.0 A(pk)				
Electrical test		Same as subgroup 2	I_{V1}	2.7 3/ 18.0 4/		
Luminous intensity						
Subgroup 8						
Peak forward pulse current (operating)		t_p = 0.5 ms, $P_{FM} \leq$ 120 mW, T_A = 25°C, I_P = 60 mA, 500 hours				
Electrical test		Same as subgroup 2	I_{V1}	2.7 3/ 18.0 4/		mcd mcd
Luminous intensity						

1/ For sampling plans, see MIL-S-19500.
2/ Electrical reject devices from the same inspection lot may be used for all subgroups when electrical end-point measurements are not required.
3/ Applies to JAN1N6094 and JANTX1N6094.
4/ Applies to JAN1N6611 and JANTX1N6611.

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TABLE IV. Group A inspection for panel mount assemblies.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 1						
External visual examination	2071					
Subgroup 2						
Luminous intensity		Same as table I	I_{V1}	3.0 2/ 20.0 3/		mcd mcd
Forward voltage		Same as table I	V_F		3.0	V dc
Reverse current		Same as table I	I_R		1.0	µA dc
Subgroups 3, 4, 5 and 6						
Not applicable						
Subgroup 7						
Solderability 4/	2026	15 devices, c = 0				
Resistance to solvents	1022	See 4.5.2 (omit 2.1d of method 1022), 45 devices, c = 0				
Physical dimensions	2066	See figure 2, 45 devices, c = 0				

1/ For sampling plan, see MIL-S-19500.
2/ Applies to JANM19500/52101 and JANTX19500/52102.
3/ Applies to JANM19500/52103 and JANTX19500/52104.
4/ The LTPD for solderability test applies to the number of leads inspected except in no case shall less than three devices be used to provide the number of leads required.

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5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with MIL-S-19500.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Notes. In addition to the notes specified in MIL-S-19500, the following are applicable to this specification.

6.2 Acquisition requirements.

a. Lead finish if other than gold plated (see 3.3.2).

b. Terminal lead length if other than as specified on figure 1 (see 3.3.3).

c. Specify the PIN for the LED or panel mount assembly as listed below:

PIN	Description
JAN1N6094	JAN LED, green, diffused lens
JANTX1N6094	JANTX LED, green, diffused lens
JAN1N6611	JAN LED, clear lens, green, sunlight viewable
JANTX1N6611	JANTX LED, clear lens, green, sunlight viewable
JANM19500/52101	JAN panel mount LED, diffused lens, green
JANTXM19500/52102	JANTX panel mount LED, diffused lens, green
JANM19500/52103	JAN panel mount LED, clear lens, green, sunlight viewable
JANTXM19500/52104	JANTX panel mount LED, clear lens, green, sunlight viewable

Sunlight viewable - for applications requiring readability in bright sunlight (see 6.4.1).

6.3 Applications. These light emitting diodes are primarily intended for use as visible indicators (ON or OFF) of status. Intensity is easily modulated by varying the forward current, so the level can be adjusted to suit ambient light conditions. The modulation rate capability can be high enough to accommodate video signals. Diodes may be operated in either a direct current or pulsed mode depending upon current availability. Pulsed operation is desirable as a means of linear control of average intensity or of improving the average efficiency (ratio of average intensity to average current). For panel applications, panel mounts should be used. Figure 2 provides information on mounting technique and hardware. The metal-can package provides precise and consistent mechanical surfaces for mounting and optical alignment.

6.4 Operating considerations. Under normal ambient light conditions (300 to 1,000 lux), a typical forward current of 6 mA is required to produce an adequate on-state luminous intensity. This current level is directly compatible with DTL and TTL devices, and only simple buffering is needed when operating from LSTTL, LTTL, CMOS, etc. No consideration of inrush current or keep-alive voltage is necessary.

6.4.1 Design considerations. Design considerations should include: Ambient light level and color; viewing background, color and texture; observer, attentiveness, position and operator accessories (glasses, goggles, etc.). Where ambient light levels are so high that it is difficult to distinguish between the LED on condition and glint (reflection of light from the surface of the LED lens), a modulated current causing a visible flicker in the LED at 10 Hz is recommended. Color filters, louvered filters and circular polarizing filters may enhance the desired visual effects of the LED. For applications in bright sunlight, sunlight viewable types are recommended. With the proper enhancement filter, these parts are readable in sunlight ambient conditions.

6.5 Reliability considerations. There is a correlation between LED luminous intensity degradation and operating current levels. To lengthen the useful life of this device, drive currents should be held to a minimum consistent with use conditions. Luminous intensity would have to change by more than 50 percent before becoming apparent to the casual observer.

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6.6 Replacement data. Device types JANM19500/52101 and JANTXM19500/52102 are direct replacements for device types M19500/521-01 and M19500/521-02, respectively.

6.7 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

CONCLUDING MATERIAL

Review activity:
DLA - ES

Preparing activity:
Army - ER

Agent:
DLA - ES

(Project 5980-A013)

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I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-S-19500/521B(ER)	2. DOCUMENT DATE *(YYMMDD)* 20 April 1992

3. DOCUMENT TITLE
Semiconductor Device, Diode, Light Emitting, Green Types JAN1N6094, JANTX1N6094

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

5. REASON FOR RECOMMENDATION

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c. ADDRESS *(Include Zip Code)*	d. TELEPHONE *(Include Area Code)* (1) Commercial (2) AUTOVON *(If applicable)*	7. DATE SUBMITTED *(YYMMDD)*

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